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FROM:

Chief, Strategic Resources Division  
Office of Global Issues

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SUBJECT:

Cuban Citrus Industry

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Agricultural Assessments Branch with contributions from  
Cuba-Caribbean Branch, Middle  
America-Caribbean Division, Office of African-Latin American  
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Attachment:

The Cuban Citrus Industry: No Help to a  
Faltering Economy GI M 85-10225,  
August 1985

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## DIRECTORATE OF INTELLIGENCE

26 AUG 1985

The Cuban Citrus Industry: No Help  
to a Faltering Economy

Summary

Havana's 15-year effort to develop its fledgling citrus industry--as a means to diversify agricultural production and boost export earnings from CEMA countries--has fallen well short of expectations. Despite a quadrupling of citrus hectareage and output, and the development of an infrastructure to support the industry, we estimate that citrus presently contributes less than one percent of total national income. Moreover, it ranks a distant second to sugar in terms of agricultural export earnings (two percent compared to 75 percent). [redacted]

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Prospects for any significant improvement during the remainder of the decade are dim. Because of obligations to CEMA, only 5 to 10 percent of Cuba's citrus exports are available for sale to hard-currency paying Western countries. In addition, hard currency shortages--particularly acute since Western creditors imposed austerity measures in 1982--are likely to continue to limit the regime's ability to expand citrus hectareage or finance imports of key agrotechnical inputs. As a result, we believe that the dramatic growth in citrus production achieved over the past ten years will slow soon and that output will level off at the one-million-ton level by 1990--1.5 million tons below plan. [redacted]

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Under these circumstances, there is little chance that Cuba will make substantial inroads into the US fresh citrus market. Should Havana's financial situation improve, the regime may eventually be in a position to boost investments to the citrus industry. These funds could be used to further expand hectareage or to purchase agrochemicals, either of which--with better orchard management--would boost production above our current projection. Given the recent completion of three modern, citrus processing plants, Cuba could begin exporting surplus quantities of juice and other by-products to the West, perhaps by the end of the decade. [redacted]

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This memorandum was prepared by [redacted] the Agricultural Assessments Branch, Strategic Resources Division, Office of Global Issues, with contributions from [redacted] Cuba-Caribbean Branch, Middle America-Caribbean Division, Office of African-Latin American Analysis. Comments and questions may be directed to [redacted] Chief, Strategic Resources Division, [redacted]

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The Cuban Citrus Industry: No Help  
To a Faltering Economy

Introduction

Since the 1959 revolution, Havana has attempted to expand and diversify its sugar-dominated economy and boost exports to CEMA trade partners. During its first two years in power, the Castro regime took more than 15 percent of the island's cane fields out of sugar production in preparation for agricultural diversification. As a result of agrarian reforms in 1959 and 1963, large landholdings were reallocated, the bulk of arable land was organized under state control, and restrictions were levied on private land ownership. Since 1963 the state has continued to expand its holdings and now directly controls close to 80 percent of the arable land. [REDACTED]

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The citrus sector was selected to serve as the centerpiece of Havana's drive to diversify traditional farm exports. Owing in large part to technical assistance from the Soviet Bloc and assured, subsidized CEMA markets for citrus, significant progress has been made. A 12 year plan launched in 1969 for massive plantings of state groves--most in areas where citrus had never been grown--resulted in an impressive expansion of the citrus sector. Prior to the revolution, citrus landholdings amounted to only 12,000 hectares, yielding an annual average of about 58,000 tons of fruit. From 1968 to 1978, according to Cuban statistics, citrus plantings more than quadrupled, increasing from 30,200 hectares to 129,500 hectares. By 1983, when many of the newer trees had begun to bear fruit, production totaled 632,000 tons and exports had reached about 380,000 tons, almost all of which was destined for the Soviet Bloc (Figure 1). Long range plans call for a further doubling of hectarage to about 250-300,000 hectares, approximately the citrus area of Florida. [REDACTED]

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Despite sizable progress, Havana has often fallen short of its announced annual goals for citrus production and exports. The shortfall is due, in our estimation, to an inability to finance either needed technological inputs or the further expansion of planted area. The financial squeeze has been particularly tight since 1982 when Havana's freewheeling import policy first came under the close scrutiny of Western official and commercial creditors attempting to roll over Cuba's hard currency debt. Hard currency shortages have especially limited the regime's ability to finance critical imports, such as Western pesticides and fertilizers, that are required to control pests and diseases and to increase yields. [REDACTED]

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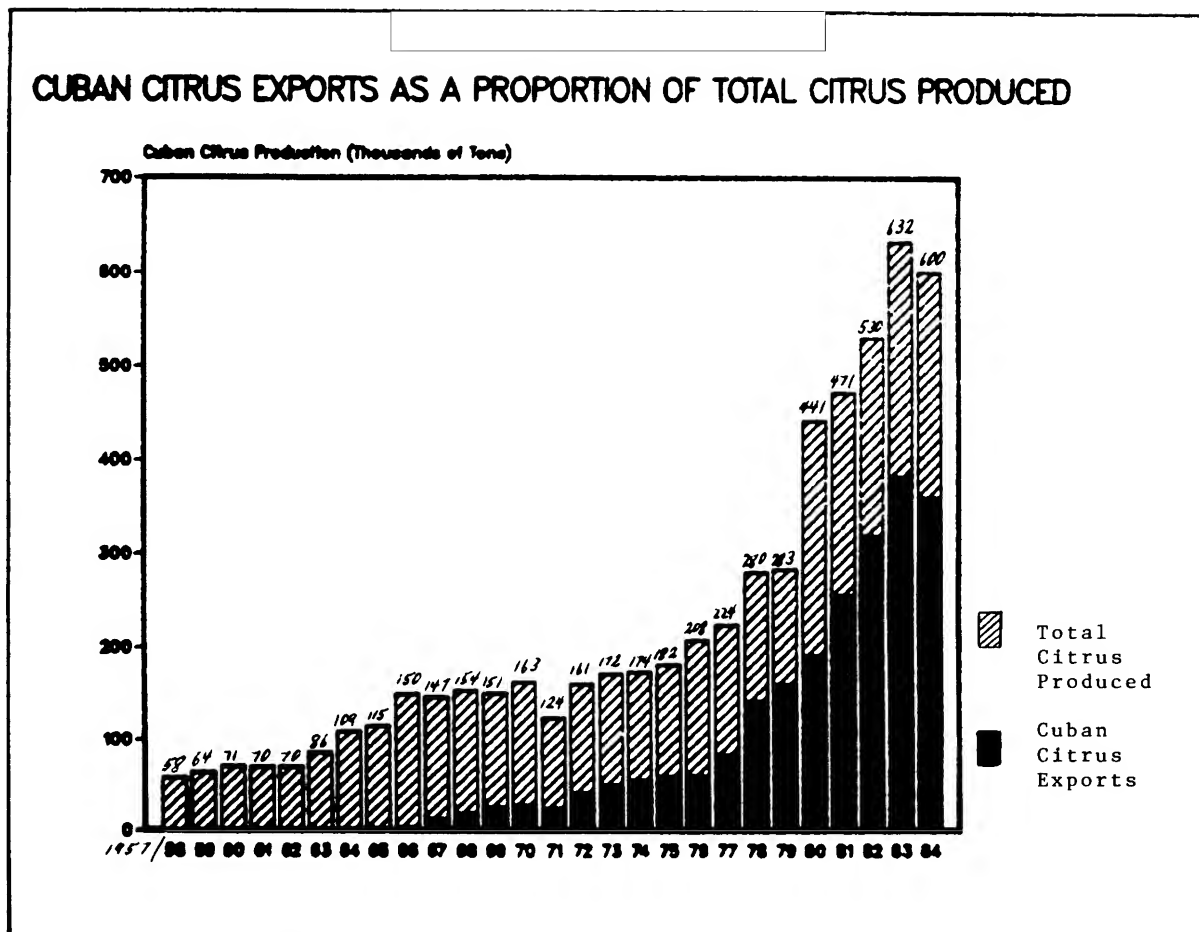
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Figure 1



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### The Agricultural Setting

**Climate.** Citrus growing conditions on Cuba are good though not ideal. The soil is a sandy to sandy loam and provides good drainage. The soil profile--about three feet--is generally adequate and the 6.5 average pH is ideal. These favorable characteristics closely resemble those of eastern Florida. The tropical climate, with little diurnal or seasonal temperature variation, also allows fruit to be harvested one-two months earlier than citrus produced in semi-tropical climates (e.g. Florida). [REDACTED]

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The Cuban climate, however, also has some drawbacks. The lack of seasonal temperature variations prevents the trees from undergoing dormancy, which, in part, causes citrus to turn its expected color, and builds sugar and aroma. Much of Cuban citrus, therefore, remains green at harvest. Most precipitation occurs during the spring-summer rainy season. Because of the seasonality of precipitation and the sandy character of the soils, the orchards must be periodically watered. Finally, pests and diseases tend to be more prolific in Cuba's tropical environment, an especially important problem because of pesticide shortages. [REDACTED]

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**Infrastructure.** Concurrent with the hectareage expansion of the 1970s, was the development of the infrastructure needed to maintain the new and larger groves and to handle increases in production. Secondary schools, termed ESBECS,<sup>1</sup> were built in hundreds of new state groves. Students attending these institutions are required to spend half of their school day helping to tend adjacent citrus plantings. Havana also constructed six experimental stations throughout the island where well-qualified scientists investigate all facets of citrus production, including variety research, breeding, pest control, cultural practices and harvesting. According to US experts, the results of these investigations are highly respected by citrus scientists worldwide. Recently, three modern large-scale citrus processing plants were completed. Along with a refurbished older plant, these facilities are enabling the Cubans to produce juices, concentrates, jams and oils both for internal consumption and planned export in the near future. [REDACTED]

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### The Role of Citrus in the Cuban Economy

Notwithstanding recent dramatic growth in Cuban citrus production, the sector still plays a relatively minor role in the Cuban economy. Although about 55-60 percent of the fruit is exported, citrus is still a distant second in terms of

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<sup>1</sup> Escuelas Secundarias Basicas en el Campo, "Basic Secondary Schools in the Country." [REDACTED]

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[redacted]

agricultural export earnings, contributing only about two percent to total export revenues as compared to approximately 75 percent for sugar. [redacted]

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As citrus production began to leap in 1980 and 1981, overly optimistic projection figures were promulgated for the rest of the decade. Plans called for Cuba to produce one million tons of citrus by 1985 and 2.5 million by 1990, of which 1.5 million would be exported. As a result of these projections, an agreement was drawn up in 1981 between Havanna and a number of CEMA countries in which the latter agreed to invest \$350 million into the further development of the Cuban citrus industry. This was seen as a method of reducing the dependence of these countries on Western citrus exports and as a means of conserving hard currency. In return, Cuba agreed to increase its exports of citrus fruits and become the main supplier for these countries. Although citrus output and exports have increased, they have fallen considerably short of expectations. [redacted]

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Approximately 90-95% of current Cuban exports are delivered to CEMA countries, with the USSR and German Democratic Republic accepting the largest deliveries (Figures 2 & 3). The remaining exports go to various Western countries early in the production season as Cuban citrus matures one to two months earlier than in Mediterranean countries or the US. Later deliveries will not sell because the quality of the Cuban fruit falls considerably short of that to which Western consumers are accustomed. [redacted]

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#### Citrus Industry Trends

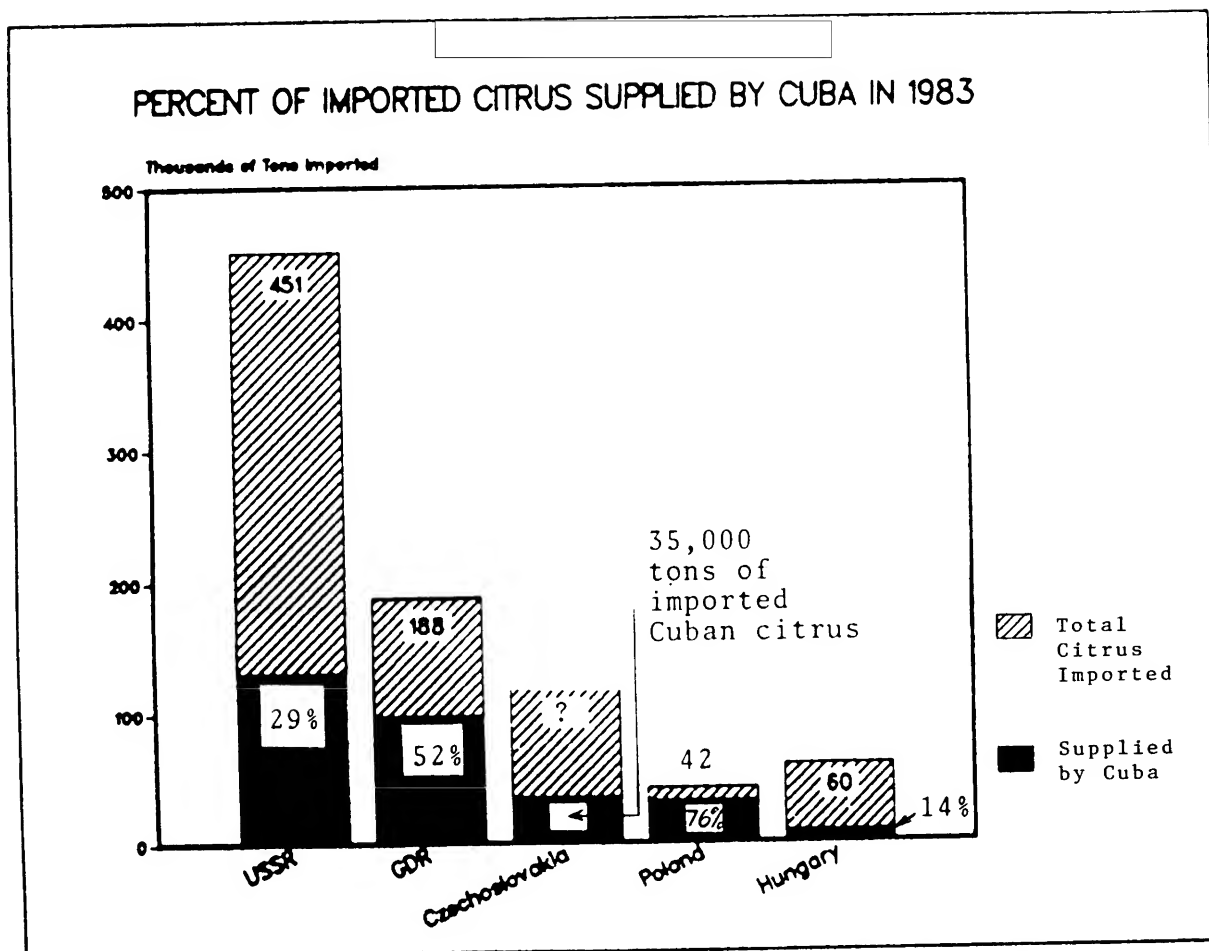
**Hectarage.** Following the rapid expansion of citrus plantings that occurred in the 1970's, hectarage in recent years has declined somewhat. Based on Cuban government statistics, planted area reached an all time high of 129,500 hectares in 1978. The average hectarage in subsequent years has only been 122,000 hectares, 10 percent of which are private landownings (Figure 4). Approximately 5,000 hectares per year were planted during this time period, generally to replace dead or diseased trees or for limited expansion of orchards with pockets of poor soil. Currently, orchards are found in all provinces of the island (Figure 5). [redacted]

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The reduction in hectarage since 1978--about 5 percent--probably is attributable to environmental and logistics problems as well as competing investment priorities. Three large hurricanes struck the island during 1979 and 1980, damaging and destroying trees and fruit. One US expert believes the Cubans also may be stabilizing citrus hectarage because increasing fruit production in the last several years has made it very difficult to keep up with harvesting, delivery, packaging and marketing. It is only within the last two years that some of the fruit could be diverted to the new processing plants for conversion to juice and other products. This logistics crunch will continue over the next couple of years as production continues to climb. [redacted]

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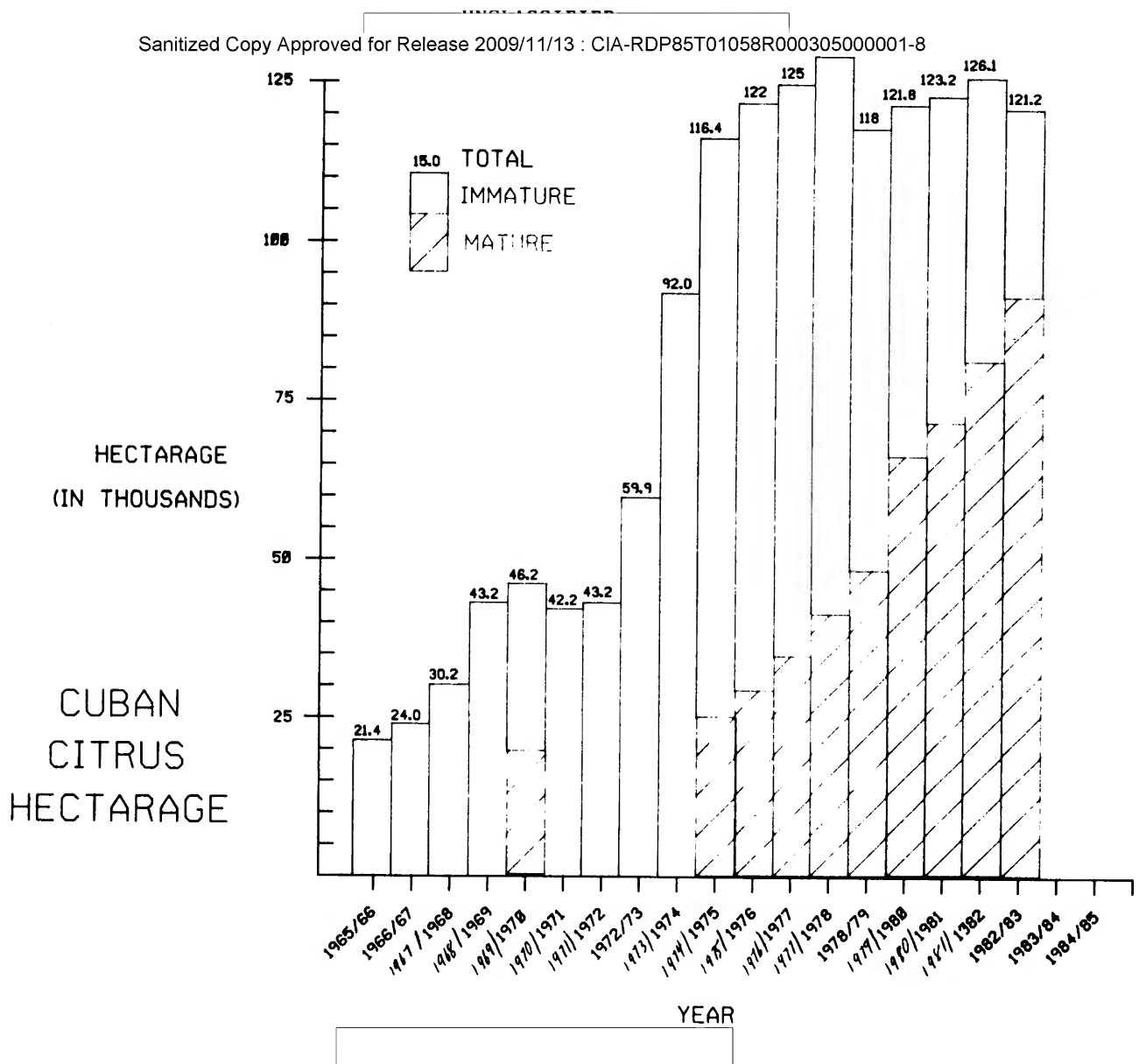
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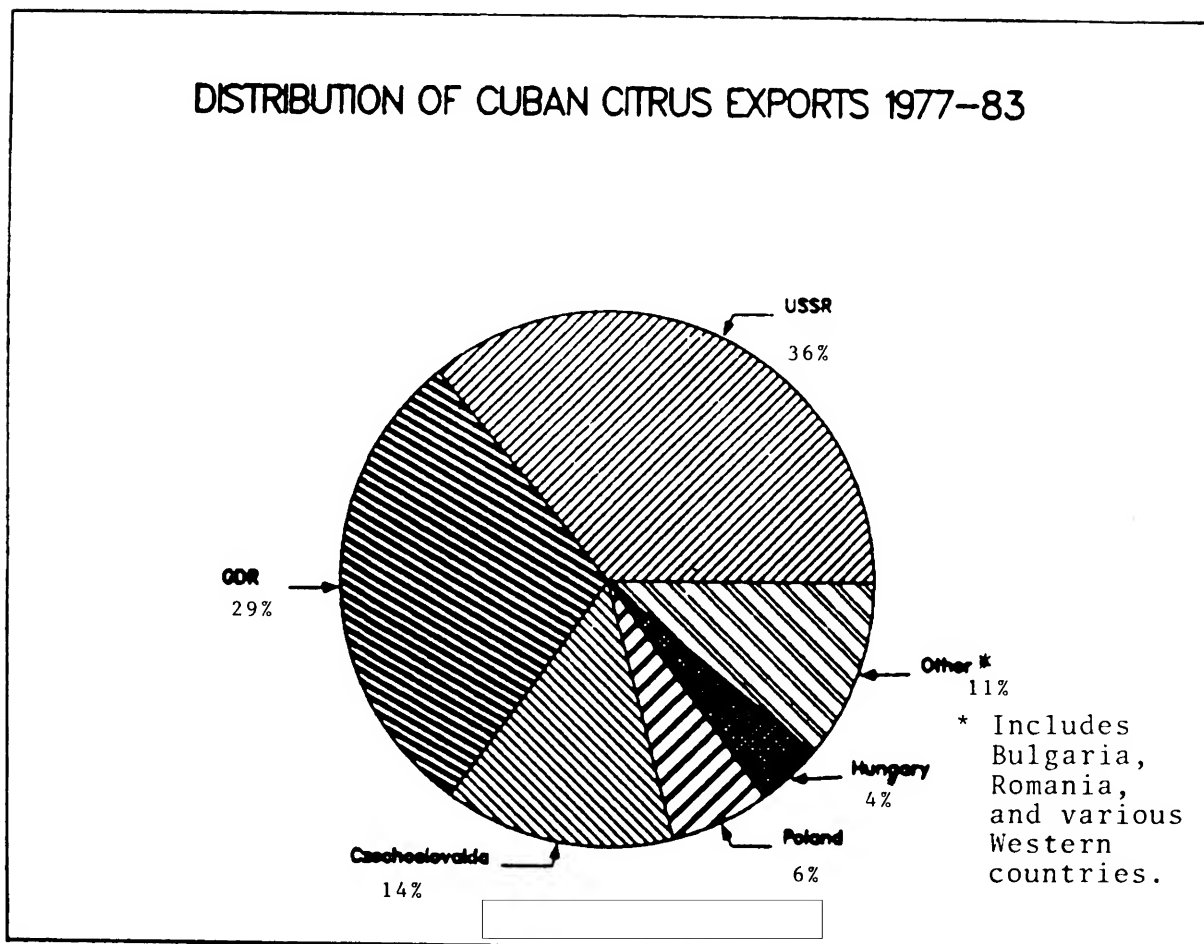
Figure 4



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Figure 2

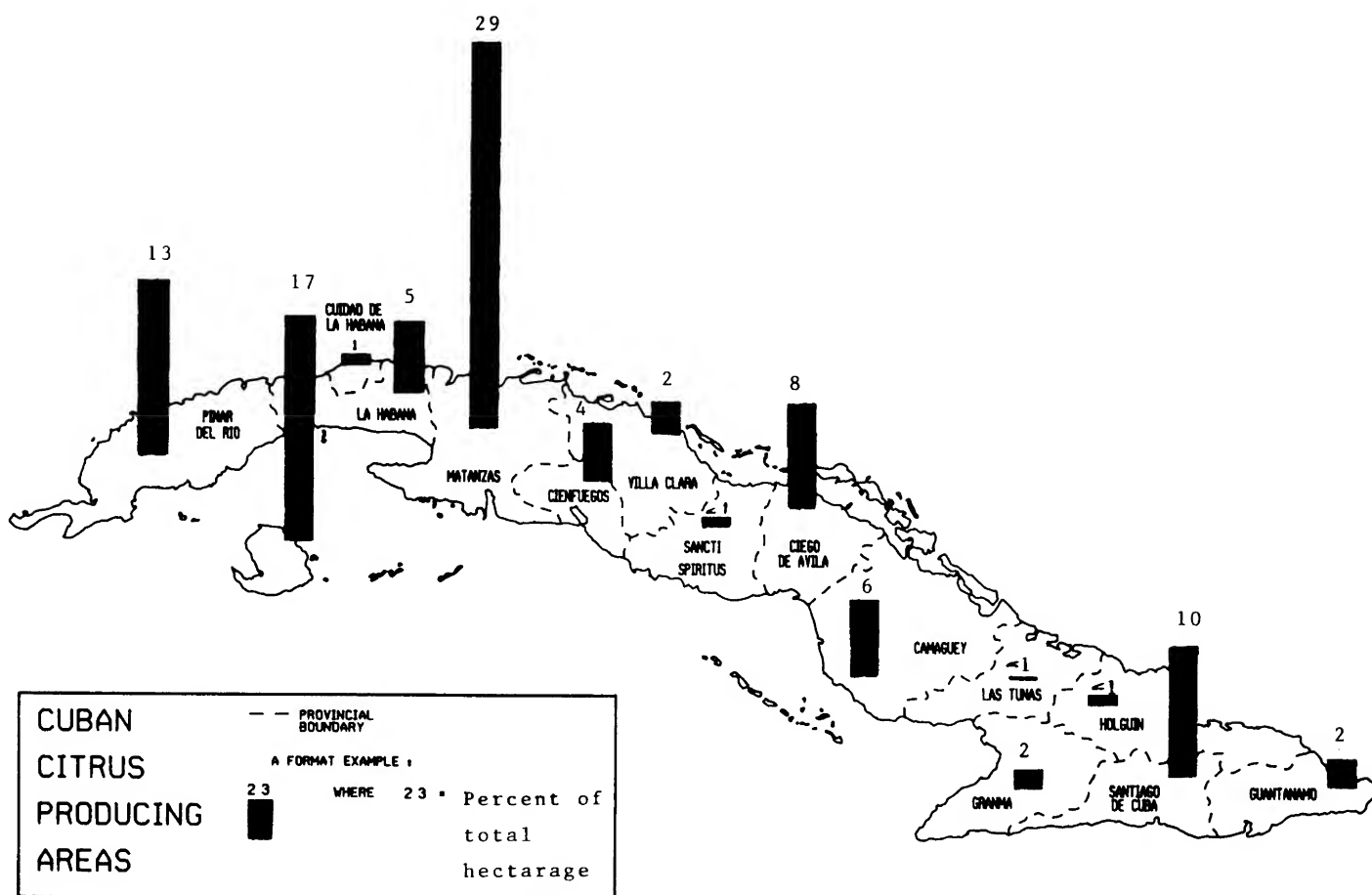


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Figure 5

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[REDACTED]

Austerity measures imposed by Western creditors have diverted Cuban investment priorities from citrus to export products for which Havana expects to be able to obtain hard currency (i.e., textiles, tobacco, leather goods and coffee). CEMA citrus delivery obligations and the need for costly Western inputs (e.g. pesticides) as well as inferior fruit quality prevent citrus from becoming a hard currency earner. This poor earnings prospect is a particular disappointment to Havana in light of the massive amount of funds already invested in the industry. [REDACTED]

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**Yields.** Cuban citrus yields are low when compared to other producing nations. The average yield of mature trees from 1975-83 was 5.4 tons per hectare compared to 25-30 tons per hectare in Florida. Furthermore, the situation is improving only very slowly; between 1975 and 1980 yields increased from 4.86 to 5.65 tons per hectare. In 1983, 6.28 tons per hectare were produced. [REDACTED]

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Several factors account for this poor performance. First, insects and diseases cause considerable fruit damage, decreasing quantity, marketability and storage life. In addition, insufficient nutrients and serious weed infestations hinder tree growth and productivity. Although yields may continue to increase in forthcoming years as better irrigation, cultivation and harvesting schedules are implemented, we believe it doubtful that yields will ever exceed 10 tons/hectare. Yields will be held to this level primarily by continued improper and inadequate applications of both fertilizers and pesticides (insecticides, fungicides and herbicides). Such agrochemicals are not currently available in sufficient quantity and Havana does not have the investment funds or technology needed to purchase or produce them. [REDACTED]

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**Production.** Despite the recent downturn in hectarage, Cuba's citrus production has continued an upward trend, principally because an ever increasing proportion of trees are attaining maturity, the stage when yields are highest. During the late 1960s and early 1970s, production ranged from about 120,000 to 160,000 tons. The very extensive plantings made from 1973 to 1976 (averaging over 23,000 hectares per year) began to mature in the late 1970s and production climbed to 441,000 tons in the 1979/80 growing season. Output continued to increase steadily and reached a record 632,000 tons in 1982/83. In the 1983/84 season production dropped to 600,000 tons due to the shortage of fertilizers and the outbreak of a severe drought (Figure 6). The drought has continued into the current production season, causing widespread water rationing and severely stressing citrus orchards. As a result this season's crop may fall below the 1983/84 level. [REDACTED]

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Over 70 percent of current Cuban hectarage is now composed of mature trees whose production will not vary dramatically given current practices. Citrus trees planted in a tropical

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Figure 6

## Cuban Citrus Statistics

	Citrus Production (Tons)				Citrus Exports (tons)	Citrus Hectarage			Yield (Tons/ Hectare)
	Oranges (Tangerines)	Grapefruit	Lemons, Limes and Other Citrus	Total		Mature	Newly Planted	Total	
1957/58	* 51,000	* 7,000		* 58,000					
1958/59	* 57,000	* 7,000		* 64,000					
1959/60	* 57,000	* 7,000	* 7,000	* 71,000	* 1,600				
1960/61	* 49,000 (* 8,000)	* 7,000	* 6,000	* 70,000	* 2,000				
1961/62	* 49,000 (* 8,000)	* 7,000	* 6,000	* 70,000	* 2,000				
1962/63	64,000 ( 8,000)	7,000	7,000	86,000	* 2,000				
1963/64	86,000 ( 5,000)	9,000	9,000	109,000	* 2,000				
1964/65	83,000 ( 8,000)	12,000	12,000	115,000	3,000				
1965/66	118,000 ( 9,000)	11,000	12,000	150,000	4,100		5,000	21,400	
1966/67	110,000 ( 13,000)	13,000	11,000	147,000	12,800		4,000	24,000	
1967/68	120,000 ( 4,000)	15,000	15,000	154,000	19,100		6,000	30,200	
1968/69	108,000 ( 12,000)	13,000	18,000	151,000	25,700		14,200	43,200	
1969/70	122,000 ( 11,000)	17,000	13,000	163,000	28,300	18,500	3,900	46,200	4.80
1970/71	85,000 ( 8,000)	14,000	17,000	124,000	25,400		1 900	42,200	
1971/72	110,000 ( 11,000)	19,000	22,000	161,000	42,500		2,900	43,200	
1972/73	114,000 ( 10,000)	25,000	23,000	172,000	50,600		21,700	59,900	
1973/74	108,000 ( 12,000)	30,000	24,000	174,000	56,000		34,500	92,000	
1974/75	127,000 ( 10,000)	25,000	20,000	182,000	59,700	23,400	25,200	116,400	4.86
1975/76	129,000 ( 20,000)	34,000	25,000	208,000	61,200	26,400	11,300	122,000	5.12
1976/77	158,000 ( 11,000)	32,000	23,000	224,000	83,600	32,200	7,700	125,000	5.09
1977/78	184,000 ( 21,000)	52,000	23,000	280,000	143,500	40,000	7,000	129,500	5.30
1978/79	184,000 ( 22,000)	52,000	25,000	283,000	161,000	45,800	4,300	118,000	4.67
1979/80	296,000 ( 30,000)	83,000	32,000	441,000	192,700	63,800	6,500	121,800	5.65
1980/81	333,000 ( 26,000)	85,000	27,000	471,000	256,000	69,100	5,200	123,200	5.61
1981/82	360,000 ( 30,000)	110,000	30,000	530,000	319,500	79,500	5,200	126,100	5.59
1982/83	432,000 ( 35,000)	125,000	40,000	632,000	382,300	84,500	4,200	121,200	6.28
1983/84	#405,000 (#35,000)	#120,000	#40,000	600,000	#360,000				

Source: FAS estimates based on FAO, Anuario Estadístico de Cuba, and Press reports.

\* USDA estimate

# CIA estimate

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environment (e.g., Cuba or Brazil) have a productive lifetime of 30-40 years before senescence, whereas plantings in a subtropical regime such as Florida will produce for at least twice that length of time. The main reason for this difference is that in a tropical environment the trees are constantly growing; they do not undergo the physiological slowing exhibited by overwintering trees in subtropical areas. [REDACTED]

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### Outlook

Havana's pressing need to allocate its scarce resources to exports that generate hard currency probably will preclude any significant increase in investment in the citrus sector over the next few years even though such action would demonstrate to Moscow that Castro intended to support his rhetorical commitments to CEMA. Indeed, citrus exports earned only \$4 million in hard currency last year and any future payoff resulting from new citrus plantings would not be realized until at least the late 1980's when trees planted this year began to produce fruit. [REDACTED]

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Even without a major investment, Cuba's crop will continue to increase during the remainder of this decade as immature trees planted in the 1970s begin to fully produce. Yearly increases, however, will tend to become smaller and the overall growth curve will plateau as the end of the decade approaches. Trend analysis indicates that by 1990, given no dramatic new expansion in hectareage and a slight increase in yield per hectare, yearly production will be approximately one million tons<sup>2</sup>--1.5 million tons short of plans adopted in the early 1980s. Some 55 to 65 percent of this production will likely be available for export and the bulk (85-90 percent) should continue to be shipped to CEMA countries. [REDACTED]

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It would take a sharp improvement in Havana's hard currency picture--an unlikely development in the near term--to permit greater resources to be diverted to citrus. If such unexpected flexibility were to develop, Havana might initiate an effort to significantly increase citrus hectareage that could rival the intensive plantings of the early 1970's. By doubling the current citrus hectareage to approximately 250,000 hectares, for example, we estimate Cuba would be able to increase the volume of exportable fruit from recent levels of less than 400,000 tons recently to well over one million tons by the mid-1990's, assuming that yields remain at about present levels. Alternatively, by providing adequate protection from pests through a major investment in pesticides, spraying equipment, and training for personnel, Cuba probably could double or even triple

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<sup>2</sup> The current severe drought over most of Cuba may reduce the 1985 and 1986 production but the long term trend should hold. [REDACTED]

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[redacted]

its current citrus production and exportable surplus by the early 1990s without expanding hectareage. In either event, such a program would represent a sizeable resource commitment well beyond what we presently think Havana can afford. [redacted]

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### Implications for the US

Assuming that CEMA will continue to import at about current levels and barring a significant investment in the citrus industry, only limited amounts of Cuban citrus will remain available for export to the West during the remainder of the decade. There is little likelihood under these circumstances that the Cubans will impinge directly on US markets for fresh citrus, but they may have an indirect effect. The Mediterranean countries of Italy, Greece, Morocco, Egypt and Turkey presently export substantial amounts of their citrus to CEMA members. Continued expansion of Cuban citrus exports to CEMA could eventually force the Mediterranean producers to divert sales to other heavy EC consumers (e.g. France, Benelux countries, UK), cutting into the US market in this area--presently about twelve percent of its total fresh citrus exports. [redacted]

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If Havana initiates a new citrus planting campaign by the end of the decade or boosts yields through better pest protection, Cuba may be able to make greater inroads into the US market by the mid-1990s. Further increases in citrus exports to CEMA would exacerbate the indirect losses to US producers resulting from the diversion of Mediterranean citrus from CEMA to Western European markets. While there is an outside chance that US producers could sustain losses in the fruit market as a result of direct competition with the Cubans, unless the quality of Cuban fresh fruit improves significantly, these losses would likely be minimal. [redacted]

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Of greater concern to US citrus growers would be the potential large-scale production of juice/concentrate products by Cuba that could result from a future surge in citrus output. Because Cuban citrus varieties are conducive to these types of processed output, Havana may eventually become a direct competitor with the United States in this market. Although no official statistics are currently available on processed citrus products, most of them probably would be consumed domestically and/or shipped to CEMA countries in the short run. But given the recent completion of the three new processing plants and the refurbishment of another, Cuba may well try to market a portion of its juice output by the end of the decade in Western markets to acquire even a small amount of additional hard currency. [redacted]

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Appendix

## The Cuban Citrus Industry in Closeup

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Cuba has tried to model its citrus program on that of the US and Brazil.<sup>3</sup> Many production policies have been adopted from what are considered the best of foreign practices. For example, all citrus nursery stock is grafted onto sour orange rootstock which is most resistant to a wide variety of diseases. All nursery plants are grown in thick soil filled polyethylene bags which facilitate easy transplanting into groves and minimize root damage. Orange trees in groves are spaced 4 by 8 meters but there has been some experimenting with larger rectangular spacings for grapefruit. These configurations allow pruning and harvesting vehicles to pass through the wider alleyways while the narrower ones grow together to form natural windbreaks.<sup>4</sup>

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The proportions of citrus fruit produced and the varieties grown closely parallel those of Florida. Slightly over two-thirds of the citrus consists of oranges, almost exclusively the "Valencia" variety. About one-fifth of production is grapefruit, mostly "Marsh" white. The remainder of plantings are tangerines (mandarins), almost totally "Dancy" with a few "Ortanique", Persian limes and some lemons (Figure 7). These and other experimental varieties and rootstocks were initially obtained indirectly from the US through third country channels.

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ESBECs

Labor in state-run citrus groves throughout Cuba as well as in some other horticultural crops (e.g., potatoes, cabbage, onions and tomatoes) consists basically of student groups. For every 500 hectare (1236 acre) section of planted grove a 500-student ESBEC is built to provide education for youngsters between the ages of 12 to 17. Students study for between three and four hours per day and then work in groves for a like period of time. All of these schools are boarding facilities where the children stay during the week and return to their parents at nearby towns every other weekend. When working in groves the

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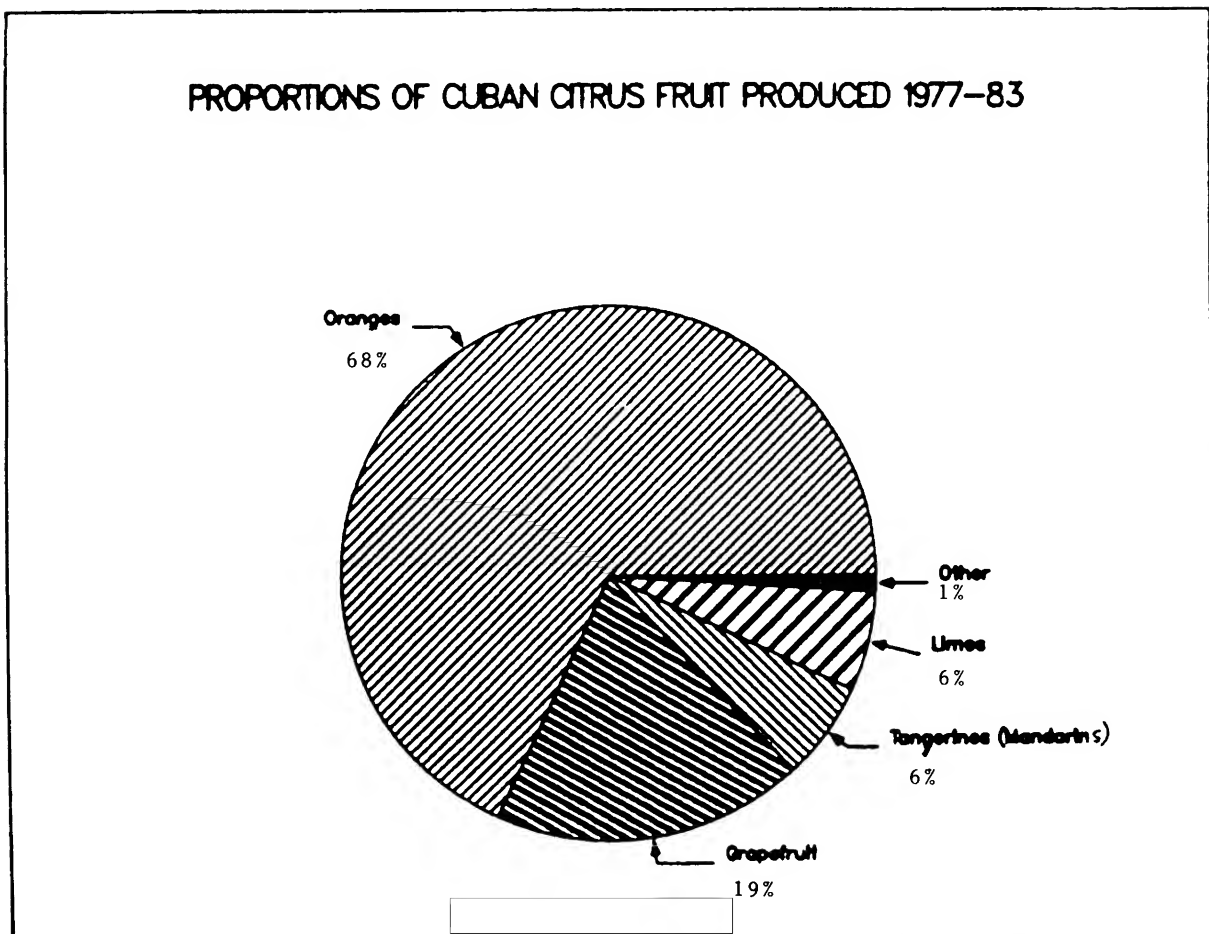
<sup>4</sup> In the past tree windbreaks were grown around the periphery of groves. They were found to be unnecessary, however, and they seriously competed for nutrients and moisture with adjacent rows of citrus. The windbreak height also created a hazard for low flying spray planes. Most of these trees have now been removed and replaced with new citrus or guava plantings.

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Figure 7



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students in all boy or all girl groups of 25 are overseen by a teacher. The female students are required to tend the citrus nurseries and young trees, whereas male students are responsible for heavier duties such as cultivation with hoes, movement of irrigation pipes and general care of older trees. All youngsters assist during harvesting, the bulk of which occurs November-May. Only difficult or dangerous labor, such as that dealing with specialized equipment or agrichemicals, is not performed by the students. [REDACTED]

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A network of asphalt roads bounds a 500 hectare school section which is subdivided into 150 meter (164 yard) square fields. Occasionally the edges of the fields are planted to guava which does well in poorer soils. Each field is numbered in a computerized accounting system to keep track of treatments and yield data. Nine sections make up a district of 4,500 hectare (11,124 acres). A grid of telephone and electrical service lines supply the sections. [REDACTED]

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The schools are located every 2,500 meters (1.35 miles) along the asphalt roads throughout citrus planted areas. Elevated 3 feet from the ground, the structures are of uniform preformed concrete slab and pier construction. They consist of a 4-story and 3-story building situated parallel to one another with a one-story dining hall between them and all three connected by a large covered walkway. A baseball field and running track are usually located adjacent to the schools. [REDACTED]

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Although a source of plentiful and inexpensive labor, the ESSEC system is not without its problems. The youngsters have caused large scale and costly errors due to improper training and lack of supervision. For example, entire orchards have had to be replanted when young trees were found to have been improperly grafted or when different species of citrus were mixed and planted in the same orchard. In addition, orchards receive minimal attention during the summer when the youngsters are on vacation. Because this occurs during the rainy season, the orchards become overrun with weeds and the trees undergo a flush of untended growth, which makes subsequent pruning more difficult. [REDACTED]

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#### Experimental Stations

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A network of six experimental stations has been established on Cuba in the principal citrus areas. They are as follows: (a) The National Station of Fruits, Havana province; (b) The National Station for the Health of Citrus and Other Fruits, City of Havana; (c) The Experimental Station of Jaguey Grande, Matanzas province; (d) The Experimental Station of Sandino, Pinar del Rio province; (e) The Experimental Station of The Isle of Youth, and (f) The Experimental Station of Contramaestre, Santiago de Cuba province. [REDACTED]

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Some of the best citrus research in Latin America has been

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conducted at these locales including work on new clones and varieties suitable to the tropical environment. Solid research with various fertilizer combinations, with differing tree spacing regimes and on control of troublesome pests has also been carried out. Not all of the knowledge acquired at these field stations is applicable for use in the groves, however, as many of the fertilizers and pesticides are not available in sufficient quantities for general distribution. Funds for research are obtained through the marketing of fruit raised on the experimental stations.

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### Private Farms

Land in state groves and research stations makes up approximately 90% of the citrus area on Cuba, the remainder is in private holdings. The size of these private orchards is limited by land reform restrictions and available labor force. Interestingly, 16% of the total citrus produce comes from these private farms.

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### Geographic Location of Orchards

Citrus orchards are scattered through all of the Cuban provinces and the Isle of Youth but the bulk of the farms are in the western and central areas (Figure 5). By far the largest citrus complex (mostly oranges) is at Jaguey Grande, Matanzas province with an area of more than 35 thousand hectares. Mostly grapefruit is grown on over 15 thousand hectares in the Camilo Cienfuegos complex, Isle of Youth. Other large orchards are located in Pinar del Rio, Santiago de Cuba and Ciego de Avila provinces. Land selected to be converted to groves is generally scrubland whose only previous use has been pasture.

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### Soil

Soil conditions on Cuba vary but are generally of a sandy or sandy loam consistency. Pockets of red clay soils with outcroppings of calcareous (limestone) rocks are encountered. In preparing an orchard, the latter are broken with dynamite when too difficult to remove by bulldozer. The soil profile generally does not exceed three feet before limestone is encountered; this is an adequate depth for citrus planting. Soil pH poses no problem as most is about 6.5 which is optimum. The very sandy soils can be 5.5 or lower and require some liming. On the Isle of Youth, where the majority of grapefruit is grown, lower pH (as low as 3.0) and a kaolin clay subsoil (impenetrable to roots) present more planting challenges.

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### Climate

Cuba has a tropical, tradewind climate that is characteristically warm and humid. Temperature variation is not great ranging from a mean of 22.5°C (72°F) in January to an average of 27.8°C (82°F) in August. Frost is never a problem as

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[redacted]

the minimum temperature is 5°C (41°F); the maximum reaches 40°C (104°F). When temperatures reach these very high levels and stay there for a number of days, a deterioration of some of the citrus trees may occur. These trees lose a number of leaves along with much of their early fruit. The quantity and quality of the fruit that does mature is decreased. [redacted]

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Precipitation varies considerably during a year and can be divided into two sharply defined seasons. During the wet or rainy season (May-October) precipitation ranges from 130 to 280 mm (5 to 11 inches) per month while in the dry season (November-April) the range is only 25 to 100 mm (1 to 4 inches) per month. Annual rainfall amounts also show sharp variations from place to place. Western Cuba and the Isle of Youth receive up to 1780 mm (70 inches) during the year while eastern areas may get less than 890 mm (35 inches). [redacted]

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Cuba is also subject to tropical storms and hurricanes. Although these may strike in almost every month of the year, they typically occur during the months of June through November. Generally affecting the western regions, the strong winds accompanying these storms often snap the tough citrus fruit stem causing considerable amounts of fruit to fall from the trees. Losses are most severe when the damaged fruit is immature, but even the marketability of ripe citrus, whose juice content may be unaffected, decreases because of external blemishes. [redacted]

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### Irrigation

Cuba's dry season and the nature of its soils necessitate irrigation of the citrus groves. Moisture during the early spring, after flowering but before the rainy season, is critical for a good crop harvest. The island has numerous sources of both ground and surface water which is passed through pumping stations into large diameter permanent concrete covered steel tubes throughout the length and breadth of the groves. Water is taken off at regularly spaced valves and fed into portable aluminum irrigation pipes. Short risers with attached Rainbird-type sprinkler heads distribute the water. [redacted]

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Not all state lands are supplied with an irrigation system although the percentage until recently exceeded 90 percent of new plantings. The most recent planting statistics for 1982 and 1983 show that only about 80 percent and 87 percent, respectively, of the new lands prepared those years were irrigated. Because the Cubans tends to irrigate on a preset schedule regardless of the need, some citrus trees become stressed from over watering. [redacted]

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### Pests

Control of various pests, including weeds, presents the Cubans with major problems. Harmful insects include the blue-green weevil, sugar cane root weevil, scale, black aphid and leaf cutting ants (which are especially debilitating to young

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trees). A number of diseases such as melanose, citrus canker and greasy spot can also cause considerable damage.<sup>5</sup> Marketability and shelf life are decreased by fruit injury. Yield losses from insects and disease can easily approach 50%. [redacted]

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Weed growth is also a severe problem in the wet season, requiring young trees to receive as many as twelve hand hoeings per year. In addition many citrus plantings were made in former pastureland of Pangolagrass, a plant very difficult to contain. Weed competition decreases potential citrus yields by some 10 to 20 percent. [redacted]

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Pesticides are being used to some extent to try and control all of the above mentioned pests but inadequate supplies are a chronic problem. Spray equipment, imported from eastern Europe, is generally inefficient and of poor design. [redacted]

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#### Packing Houses and Processing Plants

Every major citrus producing area has its own packing house(s). Here the produce is culled, with only the unblemished fruit packed in cardboard cartons for overseas delivery. The remainder is kept for domestic consumption or processing. [redacted]

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Within the last several years Cuba has erected three modern citrus fruit processing plants. The first was completed at Nueva Gerona on the Isle of Youth in 1978-79 and is capable of producing 6 tons/hour of both single strength and concentrated juice (primarily grapefruit). The second plant at Jaguey Grande, Matanzas province, was completed in 1983, and the third facility at Ceballos, Ciego de Avila province, began to operate last year. These latter two plants when fully operational each have a claimed capacity of over 50,000 tons of citrus products (i.e., juices, concentrates, jams, oils and fodder)<sup>6</sup> processed from about 170,000 tons of fruit in a 255 day work season. Many of these citrus products are consumed internally but will become available for export in the near future. [redacted]

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In addition to these new facilities, one pre-revolutionary

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<sup>5</sup> Citrus blight has recently been identified on Cuba. This condition, whose agent is still unknown, affects trees worldwide and is brought about by the plugging of xylem (water transporting) vessels. Over a period of years the trees lose progressively more leaves and fruit. Although they may continue to live for many years the best solution is removal and replacement with a vigorous young specimen budded on resistant (sour orange) rootstock. [redacted]

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<sup>6</sup> A palatable and valuable (16% protein) cattle feed is produced by adding lime to neutralize the acidity of citrus pulp. [redacted]

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processing plant is still functioning which produces only single strength juice. Located in Colon, Matanzas province, it has an announced capacity of 20,000 tons/year; formerly owned by Minute Maid it is undergoing remodeling. [redacted]

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The claimed capacities for the various plants are those that would be produced were they operating full time with a steady fruit input. As is the case in most communist countries, however, labor inefficiency is a problem. In addition, much of the fruit is not delivered in a timely manner, properly stored or quickly processed. [redacted]

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